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MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS
FISHERIES DIVISION
JOB PROGRESS REPORT

State: Montana Title: Northcentral Montana Fisheries Study
Project No.: FW-2-R016 Title: Middle Missouri River Basin - Instream Flow Studies
Job No.: 1-B Title: Planning Inventory, Fisheries

Period Covered: July 1, 1986 through June 30, 1987

ABSTRACT

Assessment of instream flow requirements for the fisheries of 25 streams in the middle Missouri River basin was continued during the report period. Analysis of instream flows for the upper Marias River depicted lower and upper wetted perimeter inflection points at averages of 238 and 492 cfs, respectively. A total of 134 WETP cross sections were established on 25 streams in the study area. Water elevation measurements were taken at these streams at least twice. Sauger and shovelnose sturgeon spawning migrations were monitored in the lower Marias River during the spring, 1987. The sauger catch rate averaged 21.7 fish per hour and the sturgeon catch rate averaged 20.0 fish per hour. The fish inventory survey was continued on the upper Marias River. Seining results indicated that the forage fish populations were excellent with an average catch rate of 462 fish per haul. The walleye spawning run was also monitored in this section of the Marias. Most of the spawning activity was located in the lower 5 mile reach of the Marias immediately above the upper end of Tiber Reservoir. Trout standing crop estimates were made in 4 tributary streams within the study area. Estimates ranged from a low of 147 fish/1000 ft. to a high of 395 fish/1000 ft.

OBJECTIVES AND DEGREE OF ATTAINMENT

The overall objectives are to inventory sport and nonsport fish populations to determine important factors upon which sport fish depend, locate critical river habitat or tributary streams for the various sport species and formulate instream flow recommendations to protect sport fish populations.

Specific objectives include the following:

1. To finish editing the Lower Missouri Basin planning and inventory report. The report has been completed.

2. To continue with fisheries instream flow analysis establishing cross sections on approximately 30 streams. Cross sections were established on 24 streams and survey data was collected.

3. To continue surveying fish populations in streams within the study area. Population estimates were made on four streams.

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4. To continue monitoring spawning migration runs in streams within the study area. Sauger, shovelnose sturgeon, walleye and rainbow trout spawning migration runs were monitored on the upper and lower Marias River.

PROCEDURES

The wetted perimeter (WETP) hydraulic simulation computer program was employed to evaluate the instream flow necessary for maintenance of important fish habitat areas in streams. This program was described in detail by Nelson (1984). Using standard surveying techniques, water surface elevations at three discharges (high, intermediate and low) were measured with a level and rod. Channel profiles will be measured at low flow.

Base flow recommendations were determined using the wetted perimeter/inflection point method. Wetted perimeter is the distance along the bottom and sides of a channel cross section in contact with water. As the flow in the stream channel decreases, the wetted perimeter also decreases, but the rate of loss of wetted perimeter is not constant throughout the entire range of flows. There is a point, called an inflection point, on the plotted curve of wetted perimeter versus flow, at which the rate of loss of wetted perimeter is significantly changed. Above the inflection point, large changes in flow cause only very small changes in wetted perimeter. Below the inflection point, the river begins to recede from the riffle bottom at an accelerated rate. In most cases, there are two inflection points relating to flows needed to maintain low and high levels of aquatic habitat potential. The flow recommendation is selected at one of these points depending upon the aquatic resources of the stream.

The electrofishing system used was adapted from the system described by Novotny and Priegal (1976). The electrofishing apparatus was a boom-type and mounted on a 14-foot aluminum McKenzie style driftboat powered by a 10 hp outboard motor.

Power was supplied by a 3,500-watt AC generator. The alternating current was delivered to a Coffelt Model VVP-10 rectifying unit which changes the alternating current to pulsed or continuous direct current. The positive electrode consisted of two circular hoops with twelve 16-inch stainless steel droppers fastened on each hoops. These electrodes were supported by fiberglass booms and were positioned about six feet in front of the boat. The negative electrodes were five foot lengths of flexible steel conduit; four suspended off each side of the boat. The unit was typically operated at 2-7 amps, 100-215 volts, 50% pulse width and a pulse frequency of 100 pulses per second. The boom electrofishing unit was utilized on the Marias River. A mobile-type electrofishing unit was used on streams between 20-300 cfs. The unit consisted of a boat (canoe or flat bottom boat) containing a hard-held mobile positive electrode, a negative electrode and a portable 1,500-watt, 115-volt AC generator. A Coffelt Model VVP-2C rectifying unit was used to change the

alternating current to various forms of pulsed direct current. For the smaller tributary streams a Coffelt Model BP-6 gas powered backpack shocker was used.

Fish captured by electrofishing were measured to the nearest 0.1 inch and weighed to the nearest 0.01 pound. A catch per unit effort (CPUE is the number of fish caught per electrofishing hour.

A two-sample removal method was used to estimate fish populations in streams smaller than 10 cfs. This involved making two electrofishing passes through a 300-600 ft. section and essentially capturing most of the fish. Leathe (1984) describes this method in detail.

Population estimates were made for trout using the following formula from Serber (1973):

$$N = \frac{(n_1)^2}{n_1 - n_2}$$

Where:

N = population estimate
n_1 = number of fish captured during the first electrofishing pass
n_2 = number of fish captured during the second electrofishing pass

The mark/recapture technique as described by Vincent (1971 and 1974) was used to estimate the trout populations in larger streams. The following formula as modified by Chapman (1951) was used:

$$N = \frac{(M+1)\ (C+1)}{(R=1)}$$

Where:

N = population estimate
M = number of marked fish
C = number of fish in the recapture sample
R = number of marked fish in the recapture sample

FINDINGS

Introduction

The Montana Water Use Act of 1973 provides that stream flow can be reserved for fish and wildlife resources. The reservation process involves submitting an application for documented instream flow needs to the Department of Natural Resources. This application is the minimum instream flow necessary to maintain a stream's fish and wildlife resources at acceptable levels. The applications and documentation for all streams with important fishery resources in the Missouri River Basin must be submitted by July 1, 1989. This study is involved with collecting pertinent fisheries field information which describes the value

of a streams resource and quantifying and recommending instream flows which would maintain these resources.

Description of Study Area

The study area includes eight tributary drainages in the middle Missouri River basin. The mainstrem streams vary in size from about 30 cfs for Shonkin Creek to 947 cfs for the Marias River (USGS 1982). These eight tributaries are labeled in Figure 1. Table 1 lists the tributary streams to the eight mainstem tributaries which will also be evaluated for possible inclusion in the instream flow study.

Table 1. List of streams which will be considered for minimum instream flow studies.

Sun River Gibson Dam - Great Falls

Marias River
Two Medicine/Cutbank Confluence - Missouri River

Belt Creek
Headwaters to - Missouri River
Tillinghast Creek
Pilgrim Creek
Logging Creek
Dry Fork Belt Creek
Big Otter Creek

Highwood Creek
Headwaters to - Missouri River

Shonkin Creek
Headwaters to - Missouri River

Judith River
Headwaters to - Missouri River
South Fork
Middle Fork
Lost Fork
Yogo Creek
East Fork of Big Spring Creek
Cottonwood Creek
Beaver Creek

Cow Creek
Headwaters to - Missouri River

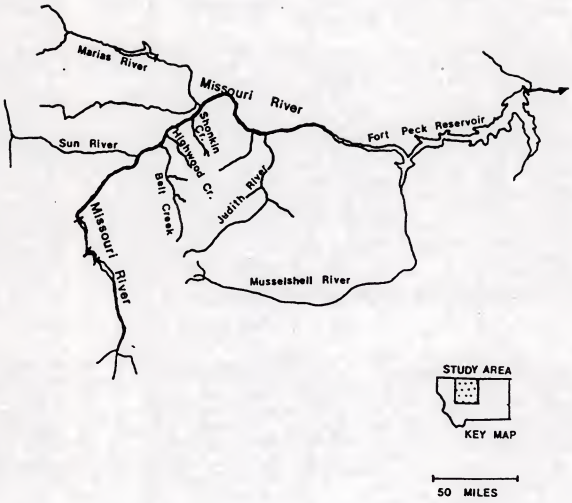


Figure 1. Map of the Study Area

The Sun and Marias rivers are 106 and 170 miles in length, respectively, and drain a major portion of the East Front of the Continental Divide and Glacier National Park in northern Montana. Both drainages have a large run-off in spring and early summer and low base flows in summer. Substantial irrigation withdrawals further act to reduce the base flows.

Belt, Highwood, Shonkin and Cow Creeks are 83, 29, 40,and 58 miles in length, respectively, and drain interior mountain ranges. They generally maintain adequate flows throughout the summer. The Judith River is 130 miles in length and drains interior mountain ranges. The upper half of this drainage usually becomes dewatered during the summer. The lower portion maintains a good base flow because of the contributions from Big Spring and Warm Spring creeks. Both streams have base flows of about 125 cfs. Only the upper portion of the 364 mile long Musselshell River will be investigated for this study. The upper reach and large tributary streams which drain portions of the Little Belts, Castle and Crazy mountains are intensively used for irrigation, consequently, chronic dewatering of some tributaries and sections of the Musselshell occur during the summer months.

Instream Flow Analysis of Basin Tributaries

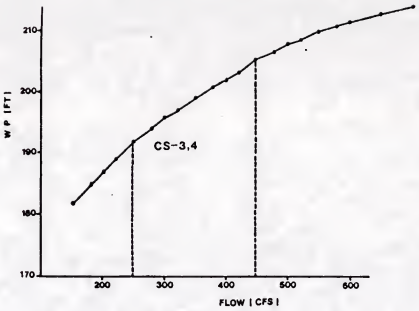
Upper Marias River

An instream `flow assessment was conducted for a 64 mile reach of the Marias River between the Cutbank Creek/Two Medicine River junction downstream to Tiber Reservoir. This assessment was concerned with identifying flows which would maintain riffles. The maintenance of suitable flows in riffles is essential for the Marias River fish populations. Riffles contain substantial standing crops of aquatic insects and forage fish, the principal food organisms of important fish species in the Marias River.

Seven cross-sections were established at four typical riffle areas. Three sets of stage-discharge data (a high, intermediate and low flow) were necessary for calibration of the WETP program. The actual water releases used for calibration were 1,270, 464 and 171 cfs. The R - values (correlation coefficients) for the cross-sections ranged between 0.980 and 0.994. The high R - Values imply there were excellent linear correlations between water elevations and flows for all cross-sections. The relationships between wetted perimeter and flow for the riffle areas are shown in Figures 2 & 3. Lower and upper inflection points occurred at averages of 238 and 492 cfs, respectively.

Other Basin Tributary Streams

Twenty-four of the most important streams in the study area were selected for instream flow analysis. A total of 28 study sites were established on these streams, with about five cross-sections located at each site. All sites were visited at least once and measurements for stream modeling were obtained (Table



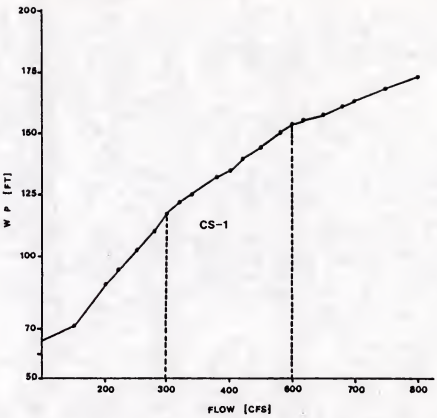


Figure 2. Wetted perimeter - discharge relationships for riffle cross-sections at Hilger (CS-3 & 4) and Naismith (CS-1) sites, Marias River, 1986.

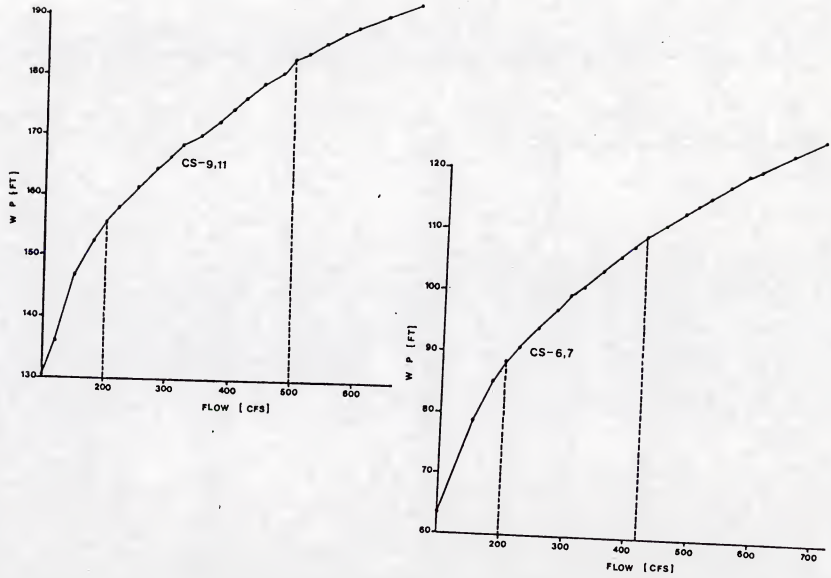


Figure 3. Wetted perimeter - discharge relationships for riffle cross-sections at Sullavin Bridge (CS-9 & 11) and I-15 Bridge (CS-6 & 7) sites, Marias River, 1986.

2). Abnormally low spring run-off conditions has prevented collection of stage measurements for high flows several streams.

Table 2. A list of study sites where stream stage height measurements have been collected at the given flows.

Study Site	Flow (cfs) High	Intermediate	Low
Sun River @ canyon	1355		119.4
Sun River @ Augusta	1510	250	106
Sun River @ Simms	561	298	215
Dry Fork Belt Cr.	29.7	22	
Pilgrim Cr.	33.5	12.9	
Logging Cr.	17.7	9.3	
Tillinghast Cr.	19.1		
Big Otter Cr.		15.2	
Little Belt Cr.			5.0
Highwood Cr.	30.2	13.3	
Shonkin Cr.	11.6		3.4
Marias River @ mouth		500	
East Fk. Spring Cr.		17.1	9.5
Cottonwood Cr.	48.2	13.2	5.2
Beaver Cr.	18.3	11.4	
So. Fk. Judith River	34.1	12.6	
Mid. Fk. Judith River	158.5	57.3	
Lost Fk. Judith River		17.6	
Judith River @ Utica	187.6	113.9	
Judith River @ Mouth	619	339	
Yogo Cr.	9.7		2.4
Cow Creek		4.7	
Upper N. Fk. Musselshell R.		6.7	
Lower N. Fk. Musselshell R.		24	9.5
Spring Cr.	13.4	7.9	
Checkerboard Cr.			2.4
S. Fk. Musselshell R.	59.3	46.6	
Cottonwood Cr.	48.8	31.7	
Alabaugh Cr.	21.0		

Fish Populations

Lower Marias River

The sauger and shovelnose sturgeon are two important sport fish which are known to spawn in the lower Marias River (Berg 1981). The lower Marias has a resident population of sauger, although sauger from the Missouri River also migrate into the Marias during the spawning season. The shovelnose sturgeon population, unlike the sauger, resides exclusively in the Missouri and at least a portion of the mature sturgeon population ascend the lower Marias to spawn. The objective of this investigation was to collect more information on the relationships between streamflow and abundances of migrating fish.

The sauger spawning run appeared to be good compared to past years. Table 3 list the dates, sizes and catch rates for this year's spawning season (17 April-25 May). The comparison with past years indicates that the 1987 spawning run was better than most years (Table 4). Flows in the river were about 500 cfs during the spawning period. An instream flow of 500 cfs appears to be adequate for attracting sauger spawners into the Marias River.

A fair number of walleye were sampled in the Marias during the spring. Catch rates of 0, 6.8 and 1.2 fish per hour were noted for the sampling dates 3 April, 17 April and 29 April, respectively. The average sizes were 16.4 inches and 1.65 pounds and nearly all were sexually mature males or females. Walleye in this spawning run are most likely residents from the Missouri River or Fort Peck Reservoir.

Table 3. Size statistics and catch rates for sauger sampled electroshocking the lower Marias River, 1987.

Date	Number	Average Length	Average Weight	CPUE 1/
3 April	7	13.5	0.69	4.7
17 April	47	13.4	0.70	20.2
29 April	39	13.5	0.76	15.6
19 May	62	13.5	0.69	24.8
5 June	65	12.3	0.52	26.0
24 June	25	12.1	0.51	10.0

1/ Catch per unit effort

Table 4. Comparison between years of the sauger spawning run in the lower Marias River. (Sample period approximately 20 April-May.

Year	CPUE
1987	21.7
1986	14.4
1985	18.3
1976-79*	27.3

*(Berg, 1981)

The spawning migration of shovelnose sturgeon usually occurs in the Marias River from late-May through mid-July (Berg 1981). The 1987 sturgeon spawning run appeared to be developing at a normal rate. Comparisons between years of the shovelnose catch rates in the six-mile study section is given in Table 5. The 1987 CPUE compares favorably with the 1976-79 and 1985 rates. Flows in the river during May and June were 500 cfs. An instream flow of 500 cfs appears to be adequate for attracting shovelnose sturgeon spawners into the Marias River.

Upper Marias River

The upper Marias River fishery was rehabilitated in 1955 in conjunction with the construction and closure of Tiber Dam. Most native warm water species were removed from the area. The sport fish presently found in this reach are mountain whitefish, rainbow trout, burbot, channel catfish and walleye.

Table 6 and 7 presents the sizes and relative catch rates for the fish sampled by electroshocking and gill netting. The data indicate that the sportfish populations in the river are at low levels. Spring electroshocking data lists a high catch rate of 18.9 walleye per hour. This catch rate was considered greater than normal and was the result of walleye migrating out of Tiber Reservoir to spawn in the river. Past studies have reported a catch rate of 1.9 walleye per hour for the late-spring and summer months (Gardner 1986).

Table 5. Comparison between years of the shovelnose sturgeon spawning run in the lower Marias River. (Sample period approximately 1 May - 30 June).

Year	CPUE
1987	20.0
1986	1.5
1985	18.8
1976-79*	20.0

*(Berg 1981)

Table 6. Species composition, number and size of fish sampled by electroshocking in the Marias River above Tiber Reservoir, April 1987.

Species	No.	Average Length	Average Range	Average Weight	Weight Range	CPUE
I-15 Section (12-36 mi. above reservoir)						
Mountain whitefish	4	13.0	9.5-17.0	1.01	0.40-1.86	0.9
Rainbow trout	6	18.9	9.6-21.9	2.76	0.30-3.75	1.4
Flathead chub	2	-		-		0.2
Longnose sucker	14	12.7	6.8-15.2	1.00	0.15-1.6	3.3
White sucker	8	12.5	8.4-20.2	1.14	0.22-3.6	1.9
"F"-Bridge Section (0-12 mi. above reservoir)						
Mountain whitefish	3	13.6	12.0-14.4	1.0	0.75-1.14	0.2
Rainbow trout	12	18.0	14.9-22.0	2.34	1.37-8.9	0.6
Northern pike	1	33.0	--	10+	--	tr.
Flathead chub	11	--	--	--	--	1-2
Longnose sucker	36	12.4	6.8-18.1	0.99	0.12-2.85	4.1
White sucker	18	12.8	8.1-17.3	1.17	0.20-2.80	2.0
Walleye	355	15.8	9.9-28.0	1.41	0.50-8.0	18.9

Table 7. Species composition, number, and size of fish sampled by experimental gill netting on the Marias River, above Tiber Reservoir. Summer 1986 (a total of 6 overnight sets)

Species	Number Captured	Average Length	Length Range	Average Weight	Weight Range	CPUE
		(inches)		(pounds)		
Mountain whitefish	1	14.5	--	1.00	--	0.17
Rainbow trout	1	17.6	--	1.71	--	0.17
Northern Pike	3	21.4	20.1-22.3	2.59	2.30-2.92	0.50
Carp	1	22.1	--	5.25	--	0.17
Flathead chub	6	7.3	6.0- 8.4	0.19	0.15-0.25	1.00
Longnose sucker	7	13.6	7.5-17.1	1.12	0.21-1.92	1.17
White sucker	15	15.4	12.4-17.6	1.62	0.80-2.33	2.50
Channel catfish	1	19.1	--	2.60	--	0.17
Walleye	5	18.5	9.6-26.3	2.87	0.29-7.12	0.83

Table 8 lists the forage fish found in the upper Marias River along with relative catch rates. The forage fish community was represented by several different species and the average catch rate of 462 fish/haul was considered high. Forage fish surveys in the middle Missouri River, for comparisons, average 322 fish/haul (Drewes 1986).

Seine catches were dominated by longnose dace, YOY Catostomus and flathead chubs. The presence of a couple YOY walleye in one seine haul verified that walleye successfully spawn and rear in the Upper Marias River.

Previous to this investigation little information was known about the spawning use of the river by resident and reservoir fish. An attempt was made to monitor spring spawning migrations and relate observations to various physical factors including instream flows. During the 1987 spring spawning season, Marias River flows ranged between 600-1000 cfs.

Electroshocking noted several sexually mature walleye in the lower 5 miles of the river and upper 2 miles of Tiber Reservoir. The walleye catch rate of 18.9 fish/hour was the highest catch rate of any species sampled in the river (Table 6). Of the 355 fish examined only 10 were females. The spawning period at least extended from 7 April through 21 April. During this period several large walleye were sampled and both male and female fish were in spawning condition.

It appears that a significant number of walleye migrate out of the reservoir and run a short distance up the Marias where they presumably spawn.

The presence of large rainbow trout was also noted while conducting electroshocking surveys. These fish were large averaging 18.3 inches and 2.48 pounds (Table 6). Their spawning condition was not determined because the fish could not be stripped of eggs or milt. It appeared that most of these fish migrated from Tiber Reservoir because trout this size are rarely sampled in the river during other seasons, and several trout of similar size were captured in trap nets at the head end of the reservoir during this same period (Bill Hill, personal communication).

Table 8. Catch rates (number of fish per seine haul) of forage fish species sampled in the Marias River above Tiber Reservoir, summer 1986. (50x4 ft. seine)

Species	Total Number	Average CPUE per haul
Carp	2	0.2
Flathead chub	844	69.3
Flathead chub (YOY)	252	42.0
Lake chub	1	0.1
Emerald shiner	70	8.7
Emerald shiner (YOY)	20	3.3
Fathead minnow	12	1.3
Longnose dace	629	69.9
Longnose dace (YOY)	663	88.2
Catostomus	1170	130.4
Longnose sucker (Juv)	168	18.8
White sucker (Juv.)	96	10.7
Yellow perch	113	13.3
Walleye	2	0.3
Mottled sculpin	7	0.8
Average CPUE =	462.3 fish/haul	
Total number hauls =	8	

Other Basin Tributaries

Standing crop estimates of fish were made in four tributary streams of the middle Missouri River basin. These estimates ranged from a low of 147 fish/1000 ft. for Pilgrim Creek to the high estimate of 395 fish/1000 ft. for Highwood Creek (Table 9). Standing crop estimates for a sample of eleven tributary streams of the Beaverhead, Big Hole and Redrock river drainages averaged 240 fish/1000 ft. and ranged between 76 and 581 fish/1000 ft. (Montana Fish, Wildlife and Parks, 1981). This indicates that trout densities listed in Table 9 are comparable with trout densities in other Montana tributary streams.

Table 9. Size statistics and standing crop estimates for fish populations in selected streams of the middle Missouri River Basin, 1986. (Fish less than 4 inches are excluded.)

Stream	Average length	Average weight	M	C	R	Estimate	No./1000 ft.	Flow
Belt Creek (Riceville) (2100 ft. section)								70 cfs
Rainbow trout	7.3	0.19	61	80	11	424	202	
Brown trout	10.4	0.76	20	19	6	59	28	
Mountain whitefish	13.2	0.93	37	15	7	76	36	
Pilgrim Creek (lower - 584 ft. section)								6.7 cfs
Cutthroat trout	5.9	0.09	80	6		86	147	
Highwood Creek (Elk Run - 450 ft. section)								7.2 cfs
Rainbow trout	7.2	0.13	43	18		74	164	
Eastern brook trout	6.0	0.09	53	26		104	231	
Shonkin Creek (Robertson - 472 ft. section)								1.9 cfs
Eastern brook trout	5.9	0.09	129	31		169	358	

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Prepared By: William M. Gardner

Date: July, 1987

CODE NUMBERS OF WATERS REFERRED TO IN THIS REPORT ARE:

20-6100	Sun River Sec. 2
20-6100	Sun River Sec. 1
14-3240	Marias River Sec. 1
14-3280	Marias River Sec. 2
16-1800	Judith River Sec. 1
16-1820	Judith River Sec. 2
16-3520	S. Fk. Judith River
16-2360	Middle Fk. Judith River
16-4260	Yogo Creek
16-1340	E. Fk. of Big Spring Creek
16-0900	Cottonwood Creek
16-0200	Beaver Creek
17-0544	Belt Creek
17-2352	Dry Fork Belt Creek
17-7680	Tillinghast Creek
17-5888	Pilgrim Creek
17-4304	Logging Creek
17-0608	Big Otter Creek
17-3456	Highwood Creek
17-6656	Shonkin Creek
16-0940	Cow Creek
18-5670	So. Fk. Musselshell River
18-0060	Alabaugh Creek
18-1380	Cottonwood Creek
18-4620	No. Fk. Musselshcell River
18-1080	Checkerboard Creek
18-2580	Flagstaff Creek
18-5820	Spring Creek